PATENT APPLICATION

AF/IPW

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE HONORABLE BOARD OF PATENT APPEALS AND INTERFERENCES

In re the Application of

Toru NOGUCHI et al.

Application No.: 10/821,175 | Examiner: E. COLE

Filed: April 9, 2004 | Docket No.: 127794

For: CARBON FIBER COMPOSITE MATERIAL AND PROCESS FOR PRODUCING THE SAME

BRIEF ON APPEAL

Appeal from Group 1794

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I. REAL PARTY IN INTEREST

The real party in interest for this appeal and the present application is Nissin Kogyo Co., Ltd., by way of an Assignment recorded in the U.S. Patent and Trademark Office at Reel 015597, Frame 0431.

II. RELATED APPEALS AND INTERFERENCES

There are no prior or pending appeals, interferences or judicial proceedings, known to Appellants, Appellants' representative, or the Assignee, that may be related to, or that will directly affect or be directly affected by or have a bearing upon, the Board's decision in the pending appeal.

III. STATUS OF CLAIMS

Claims 1-3, 6-10, 23, 24 and 26-29 are on appeal.

Claims 1-3, 6-24 and 26-29 are pending.

Claims 1-3, 6-10 23, 24 and 26-29 are rejected.

Claims 11-22 are withdrawn from consideration.

Claims 4, 5 and 25 are canceled.

IV. STATUS OF AMENDMENTS

No Amendment After Final Rejection has been filed.

V. SUMMARY OF CLAIMED SUBJECT MATTER

The summary of the subject matter of independent claims 1, 7, 8, 27 and 28 is given below with reference to the specification, as published in U.S. Patent Publication No. 2004/0241440. Appellants note that the specification has been amended since publication, and rely upon the amended text of the specification. Any reference to the specification is only exemplary and should neither be construed to encompass every portion of the specification that supports the claim features nor construed to limit the claimed subject matter beyond the claim language.

Claim 1 is directed to a carbon fiber composite material. *See* paragraph [0061]. The carbon fiber composite material has a plurality of carbon nanofibers 40 that are substantially uniformly dispersed in an elastomer 30. *See* Fig. 1 and paragraphs [0034]-[0050]. The elastomer has either an unsaturated bond or a group that has an affinity to the carbon nanofibers. *See* paragraph [0039]. The elastomer is also in its uncrosslinked form. *See* paragraph [0064]. The composite material has a first spin-spin relaxation time (T2n) of 100 to 3,000 μsec. *See* paragraph [0064]. The composite material also has a second spin-spin relaxation time (T2nn) of being absent or 1,000 to 10,000 μsec. *See* paragraph [0064]. A fraction (fnn) of components having the second spin-spin relaxation time, as compared to components having the first spin-spin relaxation time, is less than 0.2. *See* paragraphs [0064] and [0086]. The spin-spin relaxation times are measured under conditions of an observing nucleus of ^{1}H at 150 °C by the Hahn-echo method using pulsed NMR technique. *See* paragraph [0086].

Claim 7 is directed to a carbon fiber composite material. *See* paragraph [0061]. The carbon fiber composite material has a plurality of carbon nanofibers 40 that are substantially uniformly dispersed in an elastomer 30. *See* Fig. 1 and paragraphs [0034]-[0050]. The elastomer is in its uncrosslinked form. *See* paragraph [0064]. The composite material has a

first spin-spin relaxation time (T2n) of 100 to 3,000 μsec. *See* paragraph [0064]. The composite material also has a second spin-spin relaxation time (T2nn) of being absent or 1,000 to 10,000 μsec. *See* paragraph [0064]. A fraction (fnn) of components having the second spin-spin relaxation time, as compared to components having the first spin-spin relaxation time, is less than 0.2. *See* paragraphs [0064] and [0086]. The spin-spin relaxation times are measured under conditions of an observing nucleus of ^{1}H at 150 °C by the Hahn-echo method using pulsed NMR technique. *See* paragraph [0086].

Claim 8 is directed to a carbon fiber composite material. *See* paragraph [0061]. The carbon fiber composite material has a plurality of carbon nanofibers 40 that are substantially uniformly dispersed in an elastomer 30. *See* Fig. 1 and paragraphs [0034]-[0050]. The elastomer is in its crosslinked form. *See* paragraph [0065]. The composite material has a first spin-spin relaxation time (T2n) of 100 to 2,000 μsec. *See* paragraph [0065]. The composite material also has a second spin-spin relaxation time (T2nn) of being absent or 1,000 to 5,000 μsec. *See* paragraph [0065]. A fraction (fnn) of components having the second spin-spin relaxation time, as compared to components having the first spin-spin relaxation time, is less than 0.2. *See* paragraphs [0065] and [0086]. The spin-spin relaxation times are measured under conditions of an observing nucleus of ^{1}H at 150 °C by the Hahn-echo method using pulsed NMR technique. *See* paragraph [0086].

Claim 27 is directed to a carbon fiber composite material. *See* paragraph [0061]. The carbon fiber composite material has a plurality of carbon nanofibers 40 that are substantially uniformly dispersed in an elastomer 30. *See* Fig. 1 and paragraphs [0034]-[0050]. The elastomer has either an unsaturated bond or a group that has an affinity to the carbon nanofibers. *See* paragraph [0039]. The elastomer is also in its crosslinked form. *See* paragraph [0065]. The composite material has a first spin-spin relaxation time (T2n) of 100 to 2,000 μsec. *See* paragraph [0065]. The composite material also has a second spin-spin

relaxation time (T2nn) of being absent or 1,000 to 5,000 μsec. *See* paragraph [0065]. A fraction (fnn) of components having the second spin-spin relaxation time, as compared to components having the first spin-spin relaxation time, is less than 0.2. *See* paragraphs [0065] and [0086]. The spin-spin relaxation times are measured under conditions of an observing nucleus of ^{1}H at 150 °C by the Hahn-echo method using pulsed NMR technique. *See* paragraph [0086].

Claim 28 is directed to a carbon fiber composite material. *See* paragraph [0061]. The carbon fiber composite material has a plurality of carbon nanofibers 40 that are homgenously dispersed in an elastomer 30. *See* Fig. 1 and paragraphs [0034]-[0050]. The elastomer has either an unsaturated bond or a group that has an affinity to the carbon nanofibers. *See* paragraph [0039].

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

The following grounds of rejection are presented for review:

1) Claims 1-3, 6-10, 23, 24 and 26-29 are rejected under 35 U.S.C. §103(a) over WO 03/060002 to Kim in view of U.S. Patent No. 5,844,523 to Brennan et al. ("Brennan").

2) Claims 1-3, 6-10, 23, 24 and 26-29 are rejected under 35 U.S.C. §103(a) over U.S. Patent No. 6,203,814 to Fisher et al. ("Fisher") in view Brennan.

VII. ARGUMENT

Appellants respectfully request this Board to reverse the two rejections of claims 1-3, 6-10, 23, 24 and 26-29. First, none of the applied references discloses that "the composite material has a first spin-spin relaxation time (T2n) of 100 to 3,000 μsec and a second spin-spin relaxation time (T2nn) of being absent or 1,000 to 10,000 μsec" and the Final Rejection's assertion that this feature is inherent to the references lacks merit. Second, none of the applied references discloses or renders obvious a composite material having carbon nanofibers substantially uniformly dispersed in the elastomer. Finally, the evidence presented during prosecution demonstrates that the claimed invention fulfilled a long felt, but unmet need in the art. For all these reasons the rejections should be reversed.

A. Independent Claims 1, 7, 8 and 27 Would Not Have Been Obvious Over Kim in View of Brennan

The combinations of features recited in independent claims 1, 7, 8 and 27 are not disclosed or suggested by Kim and Brennan for at least two reasons. First, Kim does not inherently disclose the recited spin-spin relaxation times. Second, Kim does not disclose that the plurality of carbon nanofibers are substantially uniformly dispersed in the elastomer.

1. Kim Does Not Inherently Disclose the Recited Spin-Spin Relaxation Times

Independent claim 1 recites that "the composite material has a first spin-spin relaxation time (T2n) of 100 to 3,000 μsec and a second spin-spin relaxation time (T2nn) of being absent or 1,000 to 10,000 μsec." Claim 1 further recites that the fraction (fnn) of components that have the second spin-spin relaxation time is less than 0.2. Independent claims 7, 8 and 27 recite similar features.

The August 14, 2009 Final Rejection ("the Final Rejection") concedes that Kim and Brennan do not explicitly disclose these spin-spin relaxation times. *See* Final Rejection,

section 2, page 2. Rather, the Final Rejection asserts that this feature is inherent to the applied references. *See* Final Rejection, section 2, page 2.

Specifically, the Final Rejection asserts that because Kim discloses that "the same materials are employed and the same results are obtained, it is reasonable to presume that the materials of [Kim] would have the claimed spin-spin relaxation time." *See* Final Rejection, section 2, page 2. As discussed at length below, Appellants dispute that the same results are obtained. But even if the same results are obtained, the recited spin-spin relaxation times are not inherent features of the final product that would be produced by the process of Kim.

To establish inherency, the extrinsic evidence must make clear that the missing descriptive matter is <u>necessarily</u> present and that it would be so recognized by a person of ordinary skill. *In re Robertson*, 169 F.3d 743 (Fed. Cir. 1999). Inherency may <u>not</u> be established by probabilities or possibilities. *Id.* The mere fact that a certain thing <u>may</u> result from a given set of circumstances is not sufficient to support an inherency rejection. *Id.* In this case, spin-spin relaxation time can depend on several factors that vary in the applied references.

Kim allegedly reinforces rubber by adding carbon nanotubes and dispersing them into the rubber. The Final Rejection asserts that the same raw materials are used (i.e., rubber and nanotubes), and a material with the same desired effect is produced (reinforced rubber). *See* Final Rejection, section 2, page 2. As such, the Final Rejection asserts that the final product must have the recited spin-spin relaxation times.

The rejection lacks merit because the Final Rejection ignores that fabrication of a material can alter the properties of the material, even if identical raw materials are used as a starting point of the fabrication processes. Consider by analogy the fabrication of steel. Many steels with different properties are fabricated using identical raw materials merely by altering the fabrication process. For example, if two identical pieces of raw steel are cooled

differently, one by quenching the other by air cooling, the two final pieces of steel will have different properties.

Similarly reinforced rubber can have different properties based on how it is fabricated. This is demonstrated by the May 7, 2009 Declaration of Mr. Toru Noguchi (submitted with the May 11, 2009 Amendment). Mr. Noguchi conducted a series of tests. The purpose of the tests was to examine the effect that the method of mixing the components had on the final composite product. In these tests the <u>same</u> raw materials were used. *See* May 7, 2009 Declaration of Mr. Toru Noguchi, item 9. Specifically, in the experiments EPDM 100 parts by weight (phr) was used as the primary elastomer. *See* May 7, 2009 Declaration of Mr. Toru Noguchi, item 9. Carbon nanofibers with an average diameter of 13 nm in the amount of 10 phr and peroxide (DCP) 2 phr were used as crosslinking agents. *See* May 7, 2009 Declaration of Mr. Toru Noguchi, item 9.

Each identical set of materials was mixed using one of three different mixing methods (methods A-C). *See* May 7, 2009 Declaration of Mr. Toru Noguchi, item 10. Mixing method A was a shear rolling method as described in Appellants' specification. *See* May 7, 2009 Declaration of Mr. Toru Noguchi, item 12. Mixing method B was a general mixing method using a Labo Plastmill (Banbury mixer style). *See* May 7, 2009 Declaration of Mr. Toru Noguchi, item 13. Mixing method C used a twin screw extruder, shown in attached Fig. 3. *See* May 7, 2009 Declaration of Mr. Toru Noguchi, item 15.

The results of the tests show that Method A resulted in a first spin-spin relaxation time of 1860 μs and a second spin-spin relaxation time of 6100 μs. *See* May 7, 2009 Declaration of Mr. Toru Noguchi, Table 1. These values lie in the ranges defined in claim 1. By contrast, Method B resulted in a first spin-spin relaxation time of 3200 μs and a second spin-spin relaxation time of 12000 μs. *See* May 7, 2009 Declaration of Mr. Toru Noguchi, Table 1. Method C resulted in a first spin-spin relaxation time of 3900 μs and a second spin-spin

relaxation time of 17000 μs. *See* May 7, 2009 Declaration of Mr. Toru Noguchi, Table 1. These spin-spin relaxation times lie outside the recited range.

Thus, the spin-spin relaxation times vary based on mixing method. In other words, specific spin-spin relaxation times are not an inherent property of raw material and final product, as alleged by the Final Rejection. Rather, spin-spin relaxation times vary based on fabrication methods such as mixing methods.

This demonstrates that the recited spin-spin relaxation times would not necessarily be present in the reinforced rubber disclosed by Kim. As noted earlier, a feature is only inherent if it is <u>necessarily present</u> in a reference. *In re Robertson*, 169 F.3d at 745.

Appellants also note that the text of the Final Rejection itself demonstrates the deficiency of the rejection. The Final Rejection states that "since the same materials are employed and the same results obtains, it is <u>reasonable to presume</u> that the materials of [Kim] would have the claimed spin-spin relaxation time." *See* Final Rejection, section 2, page 2 (emphasis added). But case law states that inherency may not be established by probabilities or possibilities. *In re Robertson*, 169 F.3d at 745. The rejection must establish that the feature will necessarily be present. The conclusion drawn in the Final Rejection does not even meet this threshold. Thus, the rejection is deficient on its face.

For at least the above reasons, Kim does not inherently disclose the recited spin-spin relaxation times.

a. <u>The Final Rejection's Rebuttals to the Arguments of the May 11 Amendment</u>

The August 14, 2009 Final Rejection presents three rebuttals to the above arguments. First, the Final Rejection asserts that Appellants' specification does not disclose that a specific type of mixing is required. Second, the Final Rejection asserts that the claims do not recite that any specific method of mixing is required. Third, the Final Rejection asserts that because

Kim discloses uniform dispersion it necessarily discloses the recited spin-spin relaxation times because they are related. Appellants summarize and respond to each rebuttal below.

b. It is Irrelevant That the Specification Discloses Multiple Mixing Methods

The Final Rejection asserts that Appellants' specification indicates that multiple methods of mixing can be used to produce the recited product. *See* Final Rejection page 5, item 6. The Final Rejection quotes Appellants' specification, which states "it is only required in this [mixing] step to apply shear force sufficient to separate the aggregated fibrils." *See* Final Rejection, section 6, pages 5-6, citing Appellants' specification, paragraph [0057]. Thus, the Final Rejection appears to conclude that the May 7, 2009 Declaration of Mr. Toru Noguchi can be ignored because it contradicts the specification.

This alleged contradiction is irrelevant to whether Kim inherently discloses the recited spin-spin relaxation times for two reasons. First, there is no contradiction between the Declaration and the specification. Different mixing methods can be used to make Appellants' material if fabrication and raw material choice is tailored for the particular mixing method. (See the discussion of paragraphs [0054], [0056] and [0057] set forth below.) Second, the May 7, 2009 Declaration of Mr. Toru Noguchi was provided to show that spin-spin relaxation times can vary according to at least one fabrication step. As such, the Declaration establishes that other manufacturing methods will affect the spin-spin relaxation times.

The Final Rejection implies that the results of the May 7, 2009 Declaration of Mr. Toru Noguchi should be ignored merely because Appellants' specification implies that all of the mixing methods disclosed in his Declaration can be used to fabricate the claimed material. This is an improper interpretation of Appellants' specification. Appellants' specification requires that several factors be tailored, depending on the mixing method choice, in order to fabricate the claimed material.

For example, paragraph [0057] (cited by the Final Rejection) states that other mixing methods can be used if they apply sufficient shear force to separate aggregated carbon nanofibers. But paragraph [0056] explains that the proper level of shear force is affected and dependent on the chosen elastomer. Specifically, paragraph [0056] of Appellants' specification explains that when a "high shear force is applied" to an elastomer, "having an appropriate molecular length and a high molecular mobility" then the aggregated carbon nanotubes will be dispersed. But if the choice of elastomer is not tailored to the type of mixing method, the material may not have the recited spin-spin relaxation times. Also if the mixing method fails to provide sufficient shear force the resulting material may not have the recited spin-spin relaxation times.

Furthermore, paragraph [0054] explains that mixing temperature may vary depending on the mixing method chosen. Thus, if the mixing temperature is not tailored to the type of mixing method the final product may not have the recited spin-spin relaxation times.

None of these factors alters the fact that the May 11, 2009 Declaration of Mr. Toru Noguchi conclusively demonstrates that if a different mixing method is used without such tailoring, the final results will have varying spin-spin relaxation times. The applied references fail to disclose how to tailor fabrication to obtain the recited spin-spin relaxation times. Thus, if different mixing methods were used on the raw materials of Kim, the resulting products would have different spin-spin relaxation times.

Furthermore, the May 7, 2009 Declaration of Mr. Toru Noguchi was only used to demonstrate that altering at least one fabrication step could alter the spin-spin relaxation times. Other changes in fabrication may also affect the spin-spin relaxation times. Prior to the May 11, 2009 Declaration of Mr. Toru Noguchi, the Examiner asserted that the Examiner she had established a *prima facie* case of inherency. By demonstrating that the mixing method affects spin-spin relaxation time, Appellants have effectively rebutted the Examiner's

inherency assertion. The Examiner is not longer entitled to any presumption that other steps of manufacture (beyond mixing methods) will not also affect spin-spin relaxation time. The Final Rejection fails to present any evidence regarding its inherency allegations. Thus, the Final Rejection fails to present a *prima facie* case of inherency.

c. It is Irrelevant That the Claims Do Not Recite a Specific Mixing Method

The Final Rejection also asserts that the May 7, 2009 Declaration of Mr. Toru Noguchi fails to overcome the rejection because claims 1, 7, 8 and 27 fail to recite a specific mixing method. This rebuttal also lacks merit.

As discussed above, to establish inherency, the extrinsic evidence must make clear that the missing descriptive matter is necessarily present. *In re Robertson*, 169 F.3d at 745. The claims recite two specific spin-spin relaxation times. It is the Examiner's burden to demonstrate that Kim will always produce a final product having these spin-spin relaxation times when the same raw materials are used.

Mr. Noguchi's May 7, 2009 Declaration establishes that different mixing methods will affect the spin-spin relaxation times and therefore many of the resulting products will not have the claimed relaxation times. Thus, the Declaration establishes that Kim does not inherently produce a composite material having the recited spin-spin relaxation times.

As described previously, Appellants' disclosure teaches that different mixing methods can be used as long as various parameters are controlled so as to achieve the claimed relaxation times. Thus, it is not necessary for Appellants' claims to recite a particular mixing method. As such, the Final Rejection's rebuttal lacks merit.

d. Kim Fails to Disclose the Relationship Between Spin-Spin Relaxation Time and Dispersion

The Final Rejection's last rebuttal is that Appellants' July 31, 2006 Response states that spin-spin relaxation time is an indicator that a material has uniform dispersion of

nanofibers. See Final Rejection, Section 6, page 6. The Final Rejection argues that Kim discloses a material with substantially uniform dispersion of nanofibers. Thus, the Final Rejection reasons that this material must inherently have the recited spin-spin relaxation times.

As a preliminary matter, Appellants again first dispute that Kim discloses a material with substantially uniform dispersion of nanofibers. But assuming arguendo that Kim discloses uniformly dispersed nanofibers, the prior art does not disclose that such a material inherently has the recited spin-spin relaxation times. Rather, the relationship between dispersion and spin-spin relaxation time is only disclosed in Appellants' specification. The inherency of a feature cannot be proven using hindsight based on a relationship discovered and disclosed in an applicant's specification. *In re Rejckaert*, 9 F.3d 1531, 1533 (Fed. Cir. 1993); *also see* MPEP §2142.02(V) stating "obviousness cannot be predicated on what is not known at the time an invention is made, even if the inherency of a certain feature is later established." Instead, the prior art itself must prove the relationship.

The applied references do not disclose a relationship between nanofiber dispersion and spin-spin relaxation time. In fact the applied references do not even disclose the existence of spin-spin relaxation times. Thus, the prior art fails to show that a material having uniform dispersion will also have the recited spin-spin relaxation times. Any suggestion otherwise is the product of hindsight. Thus, the Final Rejection's rebuttal lacks merit.

2. Kim Does Not Disclose or Render Obvious Substantially Uniform Dispersion

Claim 1 recites "a plurality of carbon nanofibers substantially uniformly dispersed in the elastomer." The Final Rejection asserts that Kim discloses substantially uniform dispersion of carbon nanotubes in natural rubber. *See* Final Rejection, section 2, page 2. But

Kim only discloses a method for more uniform dispersion of the carbon nanotubes, as compared to previous methods. *See* Kim, page 5. Kim does not disclose substantially uniform dispersion. Furthermore, the Bokobza article establishes that known methods (such as Kim) had not resulted in substantially uniform dispersion as of the filing date of this application.

a. Substantially Uniform Dispersion Requires Homogenous Distribution of the Nanofibers Through the Elastomer

Substantially uniform dispersion requires that the nanofibers be homogenously dispersed in the elastomer, with the word "substantially" accounting for the normal non-perfection that is inherent in any human endeavor. Appellants' specification explains that nanofibers have a strong tendency to aggregate into clumps. See Appellants' specification, paragraph [0002]. The specification explains that this aggregation inhibits a homogenous dispersion of the nanofibers. See Appellants' specification, paragraph [0002]. The specification explains that the material produced by Appellants' method has homogenously dispersed the nanofibers into the elastomer, and prevents them from reaggregating. Appellants' specification, paragraph [0061].

b. Kim Only Discloses Obtaining More Uniform Dispersion Than Was Previously Possible

The Final Rejection asserts that Kim discloses the recited feature of substantially uniform distribution. But Kim only discloses improving nanofiber distribution (over the previous art). *See* Kim, page 5. In other words, Kim only discloses that it moved closer to the goal of substantially uniform dispersion than those before. Kim does not disclose that it reached this goal.

As evidence, consider the text of Kim. Page 5, line 13 of Kim refers to an "improvement for more uniformly distributing carbon nanotubes." (emphasis added). Likewise, line 19 refers to more uniform distribution and lines 21-22 state that the surfactants

"helped to <u>improve</u> uniform distribution." (emphasis added). The text of Kim shows that it only discloses an improvement in distribution, as compared to earlier materials. But Kim implies that further improvements are still needed to achieve homogenous distribution.

The only statement in Kim that does not contain a qualifier is found in lines 27-28, which state "the surfactants...are not limited in type as long as they distribute carbon nanotubes or GNF uniformly in the rubber." But Kim provides no disclosure or enablement of such uniform dispersion. Appellants respectfully submit that the totality of Kim shows the Mr. Kim believed he was in possession of an improvement, but Mr. Kim did not believe he had achieved substantially uniform dispersion.

c. <u>The Bokobza Article Rebuts The Final Rejection's Assertion That Kim Had Achieved Substantially Uniform Distribution</u>

As further evidence that Kim does not disclose or suggest substantially uniform dispersion of nanofibers, Appellants point to Liliane Bokobza's 2007 article entitled <u>Multiwall carbon nanotube elastomeric composites: A review</u> (submitted in the May 11, 2009 IDS) (hereinafter "Bokobza"). This article was published several years after Kim. Bokobza explains that it is difficult "to obtain a homogeneous dispersion of carbon nanotubes in a polymer matrix because van der Waals interactions between individual tubes lead to significant aggregation or agglomeration." *See* Bokobza, page 4908, col. 2.

Bokobza also explains that numerous attempts to optimize dispersion have been made. Bokobza specifically identifies that "chemical functionalization" was one of the attempted methods. *See* Bokobza, page 4908, col. 2. This is the same method allegedly disclosed by Fisher, as will be discussed further below. Yet Bokobza states that in 2007 poor dispersion continued to "limit the full utilization of carbon nanotubes for reinforcing polymeric media." *See* Bokobza Abstract. In other words, Bokobza discloses that several

years after Kim, no method had achieved substantially uniform dispersion of nanotubes in an elastomer, such as natural rubber.

As such, Appellants respectfully submit that Bokobza conclusively rebuts any assertion that Kim either discloses substantially uniform distribution or that one of ordinary skill could have optimized Kim to achieve substantially uniform distribution. Rather, Liliane Bokobza, a person of ordinary skill in the art at the time of Appellants' invention, did not believe that substantially uniform dispersion of carbon nanofibers had been achieved.

B. Independent Claims 1, 7, 8 and 27 Would Not Have Been Obvious Over Fisher in View of Brennan

The combination of features of independent claims 1, 7, 8 and 27 are also not disclosed or rendered obvious by the combination of Fisher and Brennan. First, Fisher does not inherently disclose the recited spin-spin relaxation times. Second, Fisher does not disclose a material with substantially uniformly dispersed nanofibers. Because many of the arguments in this section mirror those presented above, this section will emphasis aspects of the previous arguments in light of Fisher.

1. Fisher Does Not Inherently Disclose the Recited Spin-Spin Relaxation Times

As discussed earlier, claim 1 recites that "the composite material has a first spin-spin relaxation time (T2n) of 100 to 3,000 μsec and a second spin-spin relaxation time (T2nn) of being absent or 1,000 to 10,000 μsec...[and] a fraction (fnn) of components having the second spin-spin relaxation time of less than 0.2." Claims 7, 8 and 27 recite similar features.

The Final Rejection concedes that Fisher and Brennan do not explicitly disclose these spin-spin relaxation times. *See* Final Rejection, section 3, page 4. Rather, the Final Rejection asserts that this feature is inherent because Fisher uses the same raw materials and obtains the same product as Appellants. *See* Final Rejection, section 3, page 4. For the same reasons

articulated above, the recited spin-spin relaxation times are not an inherent feature of the final product produced by Fisher and Brennan.

To establish inherency, the extrinsic evidence must make clear that the missing descriptive matter is <u>necessarily</u> present and that it would be so recognized by person of ordinary skill. *In re Robertson*, 169 F.3d 743 (Fed. Cir. 1999). The mere fact that a certain thing <u>may</u> result from a given set of circumstances is not sufficient to support an inherency rejection. As explained above, spin-spin relaxation time can depend on several factors that vary in the applied references.

Appellants again note that the May 7, 2009 Declaration of Mr. Toru Noguchi demonstrates that even if the same raw materials are used to produce the same final product, the recited spin-spin relaxation times vary considerably. The May 7, 2009 Declaration of Mr. Toru Noguchi also demonstrates that this variation results in spin-spin relaxation times outside the recited range. This rebuts the assertions made in section 3 of the Final Rejection.

Appellants also stand on their earlier counter-arguments to the rebuttals of the Final Rejection relating to this argument.

2. <u>Fisher Does Not Disclose or Render Obvious Substantially Uniform Dispersion</u>

Claims 1, 7, 8 and 27 substantively recite a material in which a plurality of carbon nanofibers are uniformly dispersed in an elastomer. The Final Rejection asserts that Fisher renders this feature obvious. *See* Final Rejection, section 3, page 4. Specifically, the Final Rejection explains that Fisher discloses functionalizing carbon fibrils. *See* Final Rejection, section 3, page 4. This process involves bonding functional groups to the surfaces of the fibrils. *See* Final Rejection, section 3, page 4. Fisher allegedly discloses that the functional groups allows the fibrils (the alleged nanofibers) to disperse better into a polymer system (the alleged elastomer). *See* Final Rejection, section 3, page 4. The Final Rejection concludes

that "it would have been obvious to have selected the functional groups which produced the best dispersion of the functionalized fibrils into the polymer system." *See* Final Rejection, section 3, page 4.

However, this assertion is contradicted by Bokobza. As noted above, Bokobza discusses the state of the art as it existed in 2007. Bokobza explains that it is difficult "to obtain a homogeneous dispersion of carbon nanotubes in a polymer matrix because van der Waals interactions between individual tubes lead to significant aggregation or agglomeration." *See* Bokobza, page 4908, col. 2.

Bokobza also specifically identifies "chemical functionalization" as one of the numerous attempts that had been tried in the field to optimize dispersion. *See* Bokobza, page 4908, col. 2. This is the same method disclosed by Fisher. Bokobza states that the chemical functionalization approach was successful in <u>epoxy</u> matrices. *See* Bokobza, page 4909, col. 1. Yet Bokobza states that poor dispersion continues to "limit the full utilization of carbon nanotubes for reinforcing <u>polymeric media</u>." *See* Bokobza Abstract (emphasis added). Fisher discloses using chemical functionalization to disperse nanotubes in polymers. *See* Fisher, col. 7, lines 1-18. Yet Bokobza discloses that chemical functionalization had not yet yielded substantially uniform dispersion in polymers as of 2007.

Bokobza's statements conclusively rebut the Final Rejection's assertion that one of ordinary skill in the art could have modified and perfected the system of Fisher to achieve substantial uniform dispersion. To the contrary, the Bokobza article shows that Fisher <u>cannot</u> produce the recited feature.

a. <u>The Final Rejection's Rebuttal to the Above Arguments and Appellant's Counter-Argument</u>

The Final Rejection attempts to the rebut the above arguments by asserting that "Bokobza does not dismiss functionalization as failed but instead states that

functionalization...can be used to improve dispersion." *See* Final Rejection, section 8, page 8. The Final Rejection appears to assert that improving dispersion discloses the features of claims 1, 7, 8, and 27. This assertion lacks merit.

The Final Rejection is correct that Bokobza indicates that functionalization can <u>improve</u> dispersion. But claims 1, 7, 8 and 27 do not recite a material merely having improved dispersion. Rather, the claims recite substantially <u>uniform</u> dispersion. Fisher disclosed a method for moving closer to a goal that only Appellants reached. Bokobza shows that Fisher fails to reach homogenous dispersion. To put it another way, the Final Rejection states that it would have been obvious to select the functional group that "produced the best dispersion." *See* Final Rejection, section 3, page 4. But Fisher's "best" was just not good enough.

Thus, for at least the reasons above, the combination of Fisher and Brennan does not disclose or render obvious the features of independent claims 1, 7, 8 and 27.

C. <u>Independent Claim 28 Would Not Have Been Obvious Over Kim and Brennan or Fisher and Brennan</u>

Independent claim 28 recites a carbon fiber composite material comprising an elastomer and a plurality of carbon nanofibers <u>homogeneously dispersed</u> in the elastomer. As discussed earlier, the claim term "substantially uniformly dispersed" is synonymous with the term homogenously dispersed.

Appellants respectfully submit that the applied references do not disclose a carbon fiber material having the carbon nanofibers homogenously dispersed in the elastomer for the same reasons (presented above) that the references do not disclose substantially uniform dispersion. Thus, the applied references fail to disclose or render obvious the features of claim 28.

D. <u>The Claimed Invention Fulfilled a Long Felt, But Unmet Need in the Art</u>

MPEP §2144.05(III) states that a *prima facie* case of obviousness can be rebutted if the Applicant can demonstrate that the invention fulfilled a long felt, but unmet need in an art. Establishing a long-felt need requires objective evidence that (1) an art recognized problem (2) existed in the art for a long period of time (3) without solution. MPEP §716.04. The MPEP also clarifies that (4) the claimed invention must "satisfy the long felt need." MPEP §716.04. The evidence in the record establishes all four of these elements.

1. **Those of Ordinary Skill in the Art Had Been Trying to Achieve Uniform Dispersion for at Least Nine Years Prior to the Filing Date of this Application**

The evidence in the record indicates that those of ordinary skill in the art (1) recognized that uniform dispersion of nanofibers in an elastomer would be of great value and (2) were working to achieve this goal from at least 1994 to 2003. This evidence includes the August 20, 2008 Declaration of Mr. Toru Noguchi (submitted with the August 25, 2008 Amendment), the prior art cited by the Examiner, and additional references submitted by Appellants.

First, in his August 20, 2008 Declaration, Mr. Toru Noguchi certified that "it was known in the field of carbon fiber composite materials that substantially uniform dispersion of carbon nanofibers in a carbon fiber composite material would create a composite material having advantageous properties." See August 20, 2008 Declaration of Mr. Toru Noguchi. Mr. Noguchi has both extensive education, experience and credentials in the field. Thus, his sworn assertions must be given weight.

Second, both Fisher and Kim desired to improve dispersion of carbon nanofibers. Both references explain that introducing and dispersing carbon nanofibers into an elastomer would improve the tensile strength and properties of the elastomer. *See* Fisher, col. 7, lines 15-18; Kim, page 5, lines 16-18. Fisher was filed in 1994 and Kim was filed in 2003. Thus, the cited references show that those in the art were working to achieve more uniform

dispersion of carbon nanofibers in rubber and similar elastomers at least between 1994 and 2003.

Finally, as indicated above, Bokobza states that "[c]omposites obtained by dispersing nanotubes into different polymeric matrices have attracted wide attention in order to develop ultra-lightweight and extremely strong materials." Bokobza, page 4908, col. 2. Bokobza also explains "one of the biggest challenges is to obtain a homogenous dispersion of carbon nanotubes in a polymer matrix because van der Waals interactions between individual tubes often lead to significant aggregation or agglomeration, thus reducing the expected property improvements of the resulting composite." *Id.* Bokobza then states an article written by Thostenson, as well as another document, "illustrates the significant challenges that must be overcome before the potential [of carbon nanotube composites] is realized." *Id.* The Thostenson article was published in 2001. *See* Bokobza, page 4919, Reference [43]. Therefore, Bokobza, by citing Thostenson, indicates that in 2001 those in the art desired to obtain uniform dispersion of carbon nanotubes in polymers, but were unable of doing so.

Appellants' priority date is April 9, 2003. Appellants submit that the 1994 to 2003 time frame constitutes a long period of time, as required by the MPEP.

2. <u>As of April 9, 2004 No One Had Achieved Uniform Dispersion of Carbon Nanofibers in an Elastomer</u>

The evidence also shows that none of the attempts in the art had been successful prior to 2003. Bokobza states that "dispersing nanotubes into different polymeric matrices have attracted wide attention...one of the biggest challenges is to obtain a homogenous dispersion." *See* Bokobza, page 4908, col. 2, lines 19-28. Yet Bokobza concluded that "despite the fact that much progress has been made in the processing techniques, the mechanical improvement...remains minor." *See* Bokobza, page 4908, col. 2, lines 19-35.

Bokobza also states that "poor dispersion and poor interfacial bonding limit the full utilization of carbon nanotubes for reinforcing polymeric media. *See* Bokobzà Abstract.

Mr. Toru Noguchi also stated in his August 20, 2008 Declaration that prior to his, and his co-inventor's work, no one in the art had achieved uniform dispersion. Thus, Appellants submit that the Bokobza article and Mr. Noguchi's statements establish that those of ordinary skill in the art had not achieved substantially uniform dispersion of nanofibers in an elastomer prior to Appellants' disclosure.

a. The Final Rejection's Rebuttal to the Above Arguments

The Final Rejection asserts that Appellants failed to demonstrate that "if a person skilled in the art know of the teachings of Fisher and [Kim] that they would still [have been] unable to solve the problem. *See* Final Rejection, section 10, page 9. In other words, the Final Rejection appears to be asserting that Appellants have failed to demonstrate that Bokobza was specifically aware of Fisher and Kim. The Final Rejection further appears to be asserting that because Fisher and Kim allegedly disclose the recited features, and Appellants have failed to specifically show Bokobza was aware of their work, that Appellants have failed to demonstrate those in the art had not solved the long felt need.

b. Appellant's Counter-Argument to the Final Rejection

The Final Rejection's rebuttal lacks merit for several reasons. First, the MPEP does not require that an Applicant demonstrate that those in the art were specifically aware of a given reference. Second, as an apparent person of ordinary skill in the art, Ms. Bokobza is presumed to be aware of all art in the field. Third, the Bokobza article makes specific reference to the failure of Fisher's method to achieve homogenous dispersion.

The Final Rejection cites to form paragraph 7.66.04 as evidence that an Appellants must demonstrate that those in the art were aware of the references cited in the Final Rejection. Form paragraph 7.66.04 presents a ground for rejecting a Declaration asserting a

long felt, but unmet need. The grounds for rejection state "there is no evidence that if persons skilled in the art who were working on the problem know of the teachings of the above cited references, they would still be unable to solve the problem." The form paragraph cites to MPEP §716.04 as requiring this evidentiary burden.

But MPEP §716.04 does not place such a burden on an applicant. MPEP §716.04 only states those of ordinary skill must not have previously solved the problem. Appellants submit that §716.04 means that if the prior art discloses a <u>different solution</u> to the long felt need than the claimed solution it would prevent the Applicant from overcoming a rejection under §716.04. But §716.04 makes no reference to a requirement that those of ordinary skill in the art be aware of or specifically supplied with the cited references. The burden of proof required by the Final Rejection does not appear in §716.04.

A stock paragraph that adds a burden of proof upon an applicant that is not required by its corresponding MPEP section should be ignored. The text of the MPEP is controlling over any stock paragraph's interpretation. In Appellants' May 11, 2009 Amendment, Appellants' invited the Examiner to cite to any case law supporting stock paragraph 7.66.04's interpretation of §706.04. The Final Rejection provides no such citations. As such, Appellants respectfully request that this Board find that the Final Rejection has placed a burden of proof upon Appellants that exceeds that authorized by the text of the MPEP.

Furthermore, a person of ordinary skill in the art is presumed to be aware of <u>all</u> relevant art. Both Ms. Bokobza and Mr. Toru Noguchi are representative of persons of ordinary skill in the art. As such, they are entitled to the presumption that they were aware of the cited references.

In fact, the point of showing that an invention has fulfilled a long felt, but unmet need is to remove the hindsight associated with an Examiner's interpretation of a reference from interfering with reality. The theory is premised upon the notion that if <u>real people</u> of skill in

the art (rather than a hypothetical person of ordinary skill) have been unable to solve a problem for a long period of time, this should rebut any hypothetical assumption of what they may have thought was obvious.

Finally, Bokobza specifically identifies the method of Fisher and states that it had not solved the problem. Thus, Bokobza was aware of the method of Fisher. Yet Bokobza still stated that homogenous dispersion had not been achieved in polymers. Thus, Appellants have met form paragraph 7.66.04's burden with regard to Fisher.

3. **The Claimed Invention Solved this Problem and Was Heralded as a Major Breakthrough**

Finally, the claimed invention not only solved the problem of uniform dispersion, but it was widely heralded for doing so. The August 20, 2008 Declaration of Mr. Toru Noguchi stated that the inventors' work was published and received to great acclaim and fanfare at several different academic conferences. *See* August 20, 2008 Declaration of Mr. Toru Noguchi, item 11. The Declaration further states that Prof. Morinobu Endo, a world authority on carbon nanofibers, highly praised the novelty and effectiveness of the claimed material. *See* August 20, 2008 Declaration of Mr. Toru Noguchi, item 12. The Japanese Ministry of Economy, Trade and Industry also praised the claimed invention, and now funds research to further research and exploit the claimed material. *See* August 20, 2008 Declaration of Mr. Toru Noguchi, item 14. Mr. Toru Noguchi was offered (and accepted) a visiting professorship at National Shinshu University shortly after publishing his results. *See* August 20, 2008 Declaration of Mr. Toru Noguchi, item 13.

Thus, those of ordinary skill in the art acknowledged that the claimed invention had fulfilled a long felt need. Furthermore, the level of acclaim granted to the invention is presented as further evidence of both the desire in the field to achieve uniform dispersion, and the failure of those before to accomplish this feat.

For all these reasons, Appellants submit that the record shows that the claimed invention fulfilled a long felt, but unmet need in the field. As such, this rebuts the rejections presented in the Final Rejection.

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For at least the above reasons, the applied references fail to disclose or render obvious the features of independent claim 1, 7, 8, 27 and 28. Thus, withdrawal of the rejections of claims 1, 7, 8, 27 and 28 and claims 2, 3, 9, 10, 23, 24, 26 and 29 depending therefrom, is respectfully requested.

VIII. CONCLUSION

For all of the reasons discussed above, it is respectfully submitted that the rejections are in error and that the claims are in condition for allowance. For all of the above reasons, Appellants respectfully request this Honorable Board to reverse the rejections of claims 1-3, 7-10 and 23-29.

Respectfully submitted,

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Filed: February 26, 2010

APPENDIX A - CLAIMS APPENDIX

CLAIMS INVOLVED IN THE APPEAL:

1. A carbon fiber composite material comprising an elastomer and a plurality of carbon nanofibers substantially uniformly dispersed in the elastomer, wherein:

the elastomer has an unsaturated bond or a group, having affinity to the carbon nanofibers;

the elastomer in the composite material is in its uncrosslinked form; and

the composite material has a first spin-spin relaxation time (T2n) of 100 to 3,000 μsec and a second spin-spin relaxation time (T2nn) of being absent or 1,000 to 10,000 μsec, and a fraction (fnn) of components having the second spin-spin relaxation time of less than 0.2, as measured under conditions of an observing nucleus of ^{1}H at 150 °C by the Hahn-echo method using pulsed NMR technique.

2. The carbon fiber composite material according to claim 1, wherein the elastomer has a weight average molecular weight of 5,000 to 5,000,000.

3. The carbon fiber composite material according to claim 1, wherein the elastomer has, in at least one of its main chain, side chains and terminal chains, at least one member selected from the group consisting of a double bond, a triple bond, a carbonyl group, a carboxyl group, a hydroxyl group, an amino group, a nitrile group, a ketone group, an amide group, an epoxy group, an ester group, a vinyl group, a halogen group, a urethane group, a biuret group, an allophanate group, and a urea group.

6. The carbon fiber composite material according to claim 1, wherein the elastomer in the composite material is one of natural rubber (NR) and nitrile rubber (NBR).

7. A carbon fiber composite material comprising an elastomer and a plurality of carbon nanofibers substantially uniformly dispersed in the elastomer, wherein the elastomer in the composite material is in its uncrosslinked form, and the composite material has a first

spin-spin relaxation time (T2n) of 100 to 3,000 μsec and a second spin-spin relaxation time (T2nn) of being absent or 1,000 to 10,000 μsec, and a fraction (fnn) of components having the second spin-spin relaxation time of less than 0.2, as measured under conditions of an observing nucleus of ^{1}H at 150 °C by the Hahn-echo method using pulsed NMR technique.

8. A carbon fiber composite material comprising an elastomer and a plurality of carbon nanofibers substantially uniformly dispersed in the elastomer, wherein the elastomer in the composite material is in its crosslinked form, and the composite material has a first spin-spin relaxation time (T2n) of 100 to 2,000 μsec and a second spin-spin relaxation time (T2nn) of being absent or 1,000 to 5,000 μsec, and a fraction (fnn) of components having the second spin-spin relaxation time of less than 0.2, as measured under conditions of an observing nucleus of ^{1}H at 150 °C by the Hahn-echo method using pulsed NMR technique.

9. The carbon fiber composite material according to claim 1, wherein the elastomer in the composite material is in its uncrosslinked form and the composite material has a flow temperature higher than the inherent flowing temperature of the elastomer by 20 °C or more.

10. The carbon fiber composite material according to claim 1, wherein each carbon nanofiber has an average diameter of 0.5 to 500 nm.

23. The carbon fiber composite material according to claim 7, wherein the elastomer in the composite material is in its uncrosslinked form and the composite material has a flow temperature higher than the inherent flowing temperature of the elastomer by 20 °C or more.

24. The carbon fiber composite material according to claim 7, wherein each carbon nanofiber has an average diameter of 0.5 to 500 nm.

26. The carbon fiber composite material according to claim 8, wherein each carbon nanofiber has an average diameter of 0.5 to 500 nm.

27. A carbon fiber composite material comprising an elastomer and a plurality of carbon nanofibers substantially uniformly dispersed in the elastomer, wherein:

the elastomer has an unsaturated bond or a group, having affinity to the carbon nanofibers;

the elastomer in the composite material is in its crosslinked form; and

the composite material has a first spin-spin relaxation time (T2n) of its of 100 to 2,000 μsec and a second spin-spin relaxation time (T2nn) of being absent or 1,000 to 10,000 μsec, and a fraction (fnn) of components having the second spin-spin relaxation time of less than 0.2, as measured under conditions of an observing nucleus of ^{1}H at 150 °C by the Hahn-echo method using pulsed NMR technique.

28. A carbon fiber composite material comprising an elastomer and a plurality of carbon nanofibers homogeneously dispersed in the elastomer, wherein the elastomer has an unsaturated bond or group bonding with an active part of each carbon nanofiber.

29. The carbon fiber composite material according to claim 28, wherein the unsaturated bond or group bonds with a terminal radical of each carbon nanofiber.

APPENDIX B - EVIDENCE APPENDIX

A copy of each of the following items of evidence relied on by the Appellants is attached:

The August 20, 2008 Declaration of Mr. Toru Noguchi. This evidence was entered into the record by the Examiner in the November 10, 2008 Office Action.

The May 7, 2009 Declaration of Mr. Toru Noguchi. This evidence was entered into the record by the Examiner in the August 14, 2009 Office Action.

Liliane Bokobza, Multiwall carbon nanotube elastomeric composites: A review. This evidence was entered into the record by the Examiner in the August 14, 2009 Office Action.

APPENDIX C - RELATED PROCEEDINGS APPENDIX

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